CARD RECEIVING DEVICE

The invention relates to a card receiving device for completely and automatically drawing a card into the card receiving device, having a clamping unit which fixes the card, having a gear mechanism which is kinetically connected to the clamping unit, and having at least one drive which drives the gear mechanism and thus transports the clamping unit into the card receiving device.

The main focus of application of the device according to the invention is in the area of tachographs or devices for recording the operating periods and rest periods of commercial vehicle drivers. However, other applications are also feasible, for example in the area of banking and for making payments, or in locking systems. The invention is advantageously used in combination with all types of card-like data storage media. On account of the great economic and legal importance of the data which can be acquired with tachographs, the recordings have to be reliably secured against manipulation. The security measures relate both to data acquisition and data transmission and to the transmission and storage of the acquired data in the memory of the card. Relevant standards place strict requirements on the security standard to be achieved by the measures. It is therefore stipulated that the card be entirely held by the card receiving device during the reading and writing operations and be isolated from the surroundings by means of suitable closure devices. The closure devices have to be locked in the closed position during the reading and writing operations. Additional difficulties arise on account of operational failures in conventional devices caused by contamination, in particular by contact being interrupted or even when the card is being drawn in. It is problematical to draw in the card and position it exactly on the contacts of the device because the various cards

have high manufacturing tolerances in relation to the required positional accuracy with respect to the contacts of the device. Since the cards are predominantly perceived by the user to be distinguished by a high degree of robustness, said cards are generally not handled with the care that is actually required, so that, in addition to the tolerances caused by manufacture, deformation and damage impair the way in which the card operates when interacting with the card receiving devices. Furthermore, the operating conditions in motor vehicles place increased requirements on functional reliability on account of the pronounced vibrations and countless bumps and the wide-ranging temperature fluctuations. Implementing security against manipulation and the desired handling convenience mean it is necessary to draw in the card fully automatically. However, in order to meet this requirement, great difficulties are faced in terms of construction because the installation space available in a tachograph which is the size of a car radio provides only approximately a height of 10 mm for the fully automatic drawing-in process.

DP 102 08 259.6 has already disclosed a smart-card receiving device of fully automatic design, in which two clamping elements are spring-mounted on a slide, grasp the inserted smart card in the manner of tongs and transport them into a read/write position.

However, the proposed device for fully automatically and completely drawing in a card in a card receiving device is extremely complicated and has a high probability of failure on account of the large number of components. Furthermore, transporting the card to be received into the read and write positions by means of the conventional device with the precision required for reliably making contact presents problems, particularly because the long transportation path of

the clamping unit which is required to completely draw in the card is an attribute which conflicts with precise positioning in the end position. Combining accurate positioning with a long transportation path means, in the prior art, operating a particularly finely tuned gear mechanism with a precisely activatable drive over a large travel path and controlling it by means of a complex closed-loop control system. The expenditure required for this purpose produces high costs and at the same time results in unacceptably high access times.

On the basis of the problems and disadvantages of the prior art, the invention has set itself the object of providing a card receiving device which allows the card to be absolutely securely transported and reliable contact to be made in the read and write positions under the unfavorable boundary conditions explained above, and which can be produced in flat format in a manner which is cost-effective and suited to series production.

According to the invention, the object is achieved by a card receiving device of the type mentioned in the introduction, in which the card receiving device has a first gear mechanism and a second gear mechanism which are each at least temporarily driven by a drive, the gear mechanisms can be kinetically coupled to the clamping unit, the first gear mechanism is kinetically coupled to the clamping unit in a first transportation phase, and the second gear mechanism is kinetically coupled to the clamping unit in a second transportation phase.

The crucial advantage of being able to couple different gear mechanisms to the clamping unit in different transportation phases of the card clamped in the clamping unit is that the speed, positional accuracy, acceleration phases and

deceleration in movement can be matched exactly to the respective movement phase. Whereas is it desirable to draw in the card rapidly at the beginning of the transportation process once said card has been grasped, it is then necessary to precisely position the card on the contact set, which comprises the contacts, of the read and write device. In addition, the connection of different gear mechanisms simultaneously allows additional functions which are linked to the different gear mechanisms, for example driving of a locking unit for locking a closure means of the insertion opening of the device or driving an arresting unit for arresting the locking system, to be switched on and off. If appropriate, a separate alignment unit which is coupled to the second gear mechanism may also exactly position the card in the end position.

Automatic connection or coupling of the different gear mechanisms to the clamping unit or, if there is only one drive, connection or coupling between the clamping unit and this drive is particularly advantageous here. Automatic coupling or connection may be performed as a function of the transportation phase and advantageously be initiated mechanically or else by electric motor in conjunction with corresponding sensors which detect the progress of the individual transportation phases.

Installation space and production costs are reduced when only one drive is provided to drive the first gear mechanism and the second gear mechanism, the first gear mechanism and the second gear mechanism can be kinetically connected between the drive and the clamping unit, the first gear mechanism is kinetically connected between the drive and the clamping unit in a first transportation phase, and the second gear mechanism is kinetically connected between the drive and the clamping unit in a second transportation phase. The overall gear arrangement is a shiftable overall gear system with two gear mechanisms,

which can be switched on and off individually, on one drive. The probability of the arrangement failing is advantageously reduced since only one electric drive is required. Expenditure on actuating the drive or drives is also reduced in a similar way. It is expedient here to disconnect the first gear mechanism from the transmission of power between the drive and the clamping unit in the second transportation phase. The first gear mechanism advantageously differs from the second gear mechanism due to its functional incorporation. Whereas the first gear mechanism drives and controls the clamping unit and expediently also the drawing in operation, the second gear mechanism drives the fine-positioning means. In addition, it is expedient when the second gear mechanism also drives and controls a locking unit. The functions of the locking unit and the task of the fine-positioning means can expediently be linked to one another. In this case, one advantageous development provides for locking elements to push the card into an end position, preferably at the input-end edge and or rounded corners.

It is expedient for the task of the first gear mechanism when it has a toothed rack which is connected to the clamping unit, and a drive gearwheel which is connected to the drive and engages with the toothed rack in the first transportation phase. Further gear-system transmission elements, for example gearwheels or belt drives, may expediently be arranged between the drive and the toothed rack, in order to impose the desired characteristics on the movement. The use of a toothed rack is advantageous because a relatively long transportation path has to be overcome in the first transportation phase. In the case of transportation devices with rubber rollers known from the prior art, such long transportation paths need a large number of rubber rollers to be arranged in series so that the card can be completely drawn into the device.

For the transportation task of the second gear mechanism, it is expedient when the second gear mechanism has a slotted link-like first guide. A slotted link-like guide may advantageously be matched to the extremely specific movement characteristics in a second transportation phase and permits, in particular, deceleration, acceleration and even unsteady movement patterns to be implemented when the rotational speed of the drive remains the same, depending on the profile of the slotted link or the slotted link-like guide. It is possible to kinetically couple the second gear mechanism to a locking unit for locking a closure means of an input opening for the card to be received, and to control and drive the locking unit by the second gear mechanism only when two different gear mechanisms are used in accordance with the invention. It is possible to switch on functions which are linked to a gear mechanism by connecting this gear mechanism, for example to initiate locking of a locking unit by switching on the second gear mechanism, only by arranging two different gear mechanisms in accordance with the invention.

In a further refinement, it is expedient when the first gear mechanism is formed such that it is disconnected before the card reaches a read/write position, the second gear mechanism has a first guide component which can be rotated about a first axis of rotation and has a first slotted link-like guide which is formed such that it engages with a first guide element, which is connected to the clamping unit, when the first gear mechanism disengages and the first guide transports the clamping unit into the read/write position. The first guide component is expediently arranged on a first axis of rotation together with the drive gearwheel. The joint arrangement on one axis of rotation ensures the synchronization of these components and reduces the number of mounts required.

In accordance with the movement task of the clamping unit, it is expedient when the card receiving device has a first linear mount which is used to linearly mount the clamping unit in the inward direction. In this way, the degree of freedom of the movement of the clamping unit is reduced in accordance with requirements. The mount should be in the form of a sliding bearing, this being cost-effective.

In order to achieve the highest possible tolerance with respect to improper insertion of the card into the card receiving device, it is expedient when the first gear mechanism has a linear tooth system which is a constituent part of a toothed rack element, and an elastic element is arranged between the toothed rack element and the clamping unit, and the clamping unit is thus resiliently mounted on the drive of the first gear mechanism. This prevents cards which have been forcibly inserted from damaging the drive and the gear mechanism connected to the drive since the advancing movement of the card is absorbed by the elastic element which is expediently in the form of an extension spring or a compression spring. In addition, the user receives sensory feedback when the card reaches a stop which is located in the clamping unit.

It is equally expedient when the first guide element is a fixed constituent part of the toothed rack element. The first guide element is already located on that side of the gear mechanism which is protected against improper actions as a result of an elastic element being arranged as mentioned above.

The advancing movements of a slotted link-like guide are utilized in a particular manner when a second guide component having a second guide is connected to the first guide component such that it is fixed in terms of rotation, said second guide

controlling and driving a locking unit. In this case, the profiles of the guides are expediently designed to synchronously interact with the driven and controlled units of the entire device in an optimum fashion.

In order to ensure that the guide components always guide the guide elements securely, it is expedient when the guides are in the form of grooves or slots and therefore no guide elements can move out of the corresponding guide. In conjunction with the linear mounting of the clamping unit, the mechanical components are unambiguously positively controlled in each movement phase.

Additional functions can be implemented when a guide has a branch into another guide, in particular when the second guide has a branch into a third guide, into which the second guide element slides when or after the first guide element engages in the first guide.

An expedient method for sliding the second guide element into the third guide forms the subject matter of an advantageous development of the invention which proposes that the clamping unit has a stop element which strikes the actuating lever when the clamping unit moves in the inward direction, so that the second guide element moves into the third guide.

In order to ensure that the second guide does not impede or block the movement sequence during the first transportation phase, it is expedient when said guide has a circular shape which is concentric with respect to the first axis of rotation. In this way, the actuating lever is also held in one position in a controlled manner. It is similarly expedient when the first guide has two sections, a first section and a second section, the second section being in the form of a circle which

is concentric with respect to the first axis of rotation. In this way, the clamping unit remains at the same location in the card receiving device during the locking process of the closure means of the insertion opening.

In order to control the drive, it is expedient when at least one sensor signals the position of the actuating lever to a control unit. The control unit may firstly check the device is operating correctly and secondly send control signals to the drive, in particular switch off the drive or reverse the direction of rotation.

The invention is explained in greater detail below using one specific exemplary embodiment for illustration purposes and with reference to drawings, in which:

figure 1	shows a simplified perspective illustration of a clamping unit,
figures 2 and 3	each show a perspective illustration of a guide component in a view from above and, respectively, from below,
figures 4 and 5	each show a perspective illustration of an actuating lever in the view from below and, respectively, from above,
figures 6a - 9b	each show an illustration of a card receiving device according to the invention in the form of a plan view (A) and a view from below (B) in various transportation phases of the clamping unit and card, and

figure 10 shows a sequence diagram of the switching states of the drive and the gear mechanisms as a function of the transportation phase.

In the text which follows, clamping of a card to be received and drawing of a card into a card receiving device according to the invention is described with a first transportation phase, and locking of a closure means of the device and fine-positioning of the card in an end position is described with a second transportation phase. The main difference between the transportation phases is the kinematic connection of different gear mechanisms. A first gear mechanism 4 engages during the first transportation phase and a second gear mechanism 5 engages during the second transportation phase.

The clamping unit 3 illustrated in simplified form in figure 1 essentially comprises a slide 36 and a toothed rack element 15 with a tooth system 8, both constituent parts of the first gear mechanism 4, which toothed rack element 15 is resiliently attached to an extension arm 37 of the slide 36. The toothed rack element 15 is resiliently mounted in an inward direction 14 by means of an elastic element 16, specifically an extension spring 38, on the extension arm 37 of the slide 36. A first linear mount 13 runs in the inward direction 14 too and is in the form of two sliding bearing surfaces 39 which are arranged on the side of the slide 36. The slide 36 is designed as a sheet metal part and, at the input end, is provided with run-in slopes 40 for the insertion of a card 2. On the rear of a bearing surface for the card 2 on the slide 36, a stop element 35 is integrally formed on the slide 36 and strikes an actuating lever 23 (illustrated in figures 4, 5) so as to control it when a changeover is made to a second transportation phase. In addition to the tooth system 8, the toothed rack element 15, which extends in the inward direction 24, has a

first guide element 34 which is integrally connected to the toothed rack element 15.

In figures 2 and 3, a drive gearwheel 6 is provided with the reference symbol 6, a first guide component 11 is provided with the reference symbol 11, and a second guide component 17 is provided with the reference symbol 17. The two guide components 11, 17 are constituent parts of the second gear mechanism 5. The outer circumference 41 of the second guide component 17 is provided with a tooth system (not illustrated) which engages, either directly or by being connected to a gear mechanism, with an output gearwheel of an electric motor during operation. The drive gearwheel 6 for the toothed rack element 15 forms an integral component with the guide components 11, 17. The first guide component 11 has a first guide 12 with a first section 25 and a second section 26. The second section 26 is in the form of a circle which is concentric with respect to a first axis of rotation 9. If the first guide element 34 of the toothed rack element 15 moves from the first section 25 of the first guide 12, in the form of a groove, into the second section 26, the clamping unit 3 thus does not move when the guide component 11 rotates. The second guide 18, which is in the form of a groove, and the third guide 22 are shown in the view of the second guide component 17 from below illustrated in figure 3. The second guide 18 and the third guide 22 are connected to one another in a branch 21. During operation, the guides 18, 22 of the second guide component 17 guide a second guide element 42 which is attached to the actuating lever 23 of figures 4, 5. During the first transportation phase, while the first gear mechanism 4 ensures clamping and that the clamping unit 3 advances, the second guide element 42 of the second gear mechanism is located in the second guide 18 which is in the form of a concentric circle around the axis of rotation 9, with the result that the second guide element 42 does not move in

the first transportation phase and the actuating lever 23 is at rest. The second gear mechanism 5 therefore does not make any kinematic contribution to the movement in the first transportation phase.

In figures 4 and 5, the actuating lever is provided with the reference symbol 23. The actuating lever 23 is in the form of a flat sheet metal component and, in a second axis of rotation 20, has a protrusion 43 for mounting the actuating lever 23 in a recess (not illustrated) in a base carrier 48 illustrated in figures 6a to 9b. The actuating lever 23 is provided with a stop 45 which is in the form of a recess 44 and, during operation, interacts with the stop element 35 such that when a changeover is made from a first transportation phase of the card 2 to the second transportation phase, the stop element 35 of the clamping unit strikes the stop 45 of the actuating lever 23 and, in this way, the second guide element 42 in the branch 21 passes from the second guide 18 to the third guide 22. Since the actuating lever 23 controls and drives a locking unit 31 (not illustrated) for locking a closure means (not illustrated) of an insertion opening (not illustrated) in the card receiving device, said actuating lever is provided with a third guide element 44 and a fourth guide element 45 which are each in the form of a protrusion and engage in corresponding recesses in the locking unit.

Figures 6a to 9b each show a plan view and a view from below of the card receiving device 1 in combination with the functionally important components in different movement phases. In the movement phase of the first transportation phase illustrated in figure 6a, 6b, the card 2 is already inserted into the card receiving device 1 and a sensor (not illustrated) has switched on the drive (not illustrated). The drive gearwheel 6 drives the toothed rack element 15, so that the

card 2 moves in the inward direction 14. The card 2 is clamped in the clamping unit 3 in a manner which is not illustrated in any greater detail. At this point, the first guide element 34 does not yet engage with the first guide 12.

As can be seen from figure 6b, the second guide element 42 engages with the second guide 18 of the second guide component 17. The second guide element 42 which is connected to the actuating lever 23 does not move at this point because the second guide 18 has a circular shape which is concentric about the first axis of rotation 9. Therefore, the actuating lever 23 also remains at rest.

In the movement phase of the first transportation phase illustrated in figures 7a and 7b, the device is just about to make the changeover from the first transportation phase, which moves the card 2 into the card receiving device 1 in a translatory fashion, to the second transportation phase, during which the card 2 remains at a standstill in the card receiving device 1 and a second gear mechanism 5 takes over control and operation of a locking unit (not illustrated). As illustrated in figure 7a, the drive gearwheel 6 disengages from the toothed rack element 15, the first guide element 34 moves into the first section 25 of the first guide 12 and the stop element 35 of the clamping unit 3 strikes the actuating lever 23 on the stop 45, with the result that the actuating lever 23 rotates about the second axis of rotation 20 in such a way that the second guide element 42 in the branch 21 moves from the second guide 18 into the third guide 22.

During the movement phase of the second transportation phase illustrated in figures 8a and 8b, the drive gearwheel 6 is completely disengaged from the tooth system 8 of the toothed rack 15. On account of the gradient of the first section 25 of

the second guide 18, the clamping unit 3 is moved into an end position in a translatory fashion and at the same time has struck the stop 45 in the recess 44 of the actuating lever 23 by means of the stop element 35, with the result that the actuating lever has rotated about the second axis of rotation 20 and the second guide element 42 has moved into the third guide 22. During a second part of the second transportation phase, the first guide element 34 is located in the second section 26, which is in the form of a concentric circle around the first axis of rotation 9, of the first guide 12, with the result that the clamping unit 3 remains at rest. Guiding the second guide element 42 in the third guide 22 causes the actuating lever 23, which operates a locking unit (not illustrated) by means of the guide elements 46, 47, to pivot.

Figures 9a, 9b illustrate the end of the second transportation phase. The first guide element 34 and the second guide element 42 are each located at the end of the second section 26 of the first guide 12 and, respectively, at the end of the third guide 22. Sensors (not illustrated) have registered the position of the actuating lever 23 and switched off the drive (not illustrated) by means of a control unit (not illustrated).

The sequence diagram from figure 10 shows the switch-on and switch-off states of the second gear mechanism 5, of the first gear mechanism 4 and of the drive E. Before the movement phase T1 of a first transportation phase TP1, the card 2 is inserted into the card receiving device 1 and the drive E is started. The first gear mechanism 4 is coupled to the drive E and transports the card 2 and, respectively, the clamping unit 3 in the inward direction 14 by means of the toothed rack 15. At the beginning of a second transportation phase TP2 in the movement phase T2, the first gear mechanism 4 disengages and the second gear mechanism 5 begins to transport the card 2 further. During

the changeover from the first transportation phase TP1 to the second transportation phase TP2, the second gear mechanism 5 starts in a movement phase T2a if the first gear mechanism 4 is still engaged. The first gear mechanism 4 remains engaged with the second gear mechanism 5 in an overlapping fashion up until the movement phase T2b, in order to ensure a clean changeover O. At the start of the second transportation phase TP2, the first guide element 34 moves into the first section 25 of the first guide 12 and the drive gearwheel 6 disengages from the toothed rack element 15. Following the movement phase T2b, a phase of fine positioning F takes place, in which means (not illustrated) in the form of a locking unit push the inserted card 2, at the input-end edge in the inward direction 14, against an end stop of a contact set into an end position in a manner driven by the second gear mechanism 5. At the start of fine positioning F, the clamping effect of the clamping unit 3 is released from the card 2 as a function of the transportation phase, with the result that the freedom of movement required for the purpose of fine positioning is produced. In a movement phase T3 of the second transportation phase TP2, the second gear mechanism 5 completes the translatory transportation of the card 2 into the card receiving device 1, the second guide element 42 moves from the second guide 18 into the third guide 22 via the branch 21 by the stop element 35 of the actuating lever 23 striking the stop 45, and the locking unit is operated by the actuating lever 23. In the movement phase T4, sensors establish that the actuating lever 23 is in the end position and the drive E is switched off. The card 2 has reached the end position in the card receiving device.